

IV.—On the Ventriculidæ of the Chalk; their classification.

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[Continued from vol. xx. 1st Series, p. 191.]

I HAVE thus described with some detail the structure which marks a large group of fossils from the chalk, and have further endeavoured to show what are the natural affinities of the group thus marked. The only clue has thus been obtained towards arranging, in a true and natural classification, those widely varied forms to which, under various secondary modifications, this structure belongs. The few of these which have hitherto been known have been uncharacterized except by names as various as the different writers, and which, being names merely, could leave no impression of reality on the mind of the inquirer.

It will assist the inquirer, and will much enhance the importance of the present investigation, if, before entering on the description of their modifications, something is said of the stratigraphical distribution of these fossils.

From what has already been stated, it will be obvious that these fossils require to be *sought*: they can seldom fall in the collector's way as do fossils having solid parts, Testacea, Vertebrata, &c. If found at all in the hands of the dealer they will usually be fragmentary only, or in a matrix, the flint, the deceptive character of whose obvious appearances has been already shown. By far the greater part of the forms assumed are, besides, such that no blow of the hammer can disclose the character of the fossil.

It is necessary to premise thus much that it may be understood that the fact of these fossils not having yet been recognized in particular localities or strata is no proof that they do not exist therein; and, now that the true structure characteristic of them has been described, it may be hoped that the presence of some representatives of the family may be detected much more widely than has been hitherto suspected. A mere fragment may now serve for the detection of that presence*.

As far as can be gathered from the various authorities already cited, it would appear that these fossils are more abundant in England than in any other country. In the chalk of Kent, Sussex, Norfolk, Wiltshire, and the respectively adjoining localities, some of the forms are abundant, though in each region the localities in which they abound are certainly restricted. In the chalk of Yorkshire they appear to be much less abundant. Indeed many bodies which have heretofore been grouped as *Ventriculidæ* from that region have no relation to that family; while

* Of course not for the determination of species, or, necessarily, even of genus.

the forms hitherto collected there of true *Ventriculidæ* are very rare, if we may judge from the specimens in the museum of the Yorkshire Philosophical Institution, for the opportunity of carefully inspecting which specimens I am indebted to the courtesy of Mr. Charlesworth*. In England these fossils have not hitherto been recognized in any other than the Cretaceous group. It is probable that careful search will reveal them throughout all the members of that group. At present they have been found in five divisions of it; viz. the Upper Chalk, the Middle Chalk, the Lower Chalk, the Chalk Marl, and the Upper Greensand. The prevalence indeed of certain forms is characteristic of certain of these divisions†; a result which unexpectedly displayed itself after the classification presently to be exhibited had been worked out from a cautious study of the individuals, and the value of which result must therefore strike every inquirer. The particular divisions characterized by the predominance of one or the other class of forms will be shown in severally describing those forms.

There is no *à priori* reason why representatives of these forms should not be found in older and in newer formations than these cretaceous beds. Still the fact of their not having been thus found in England, where, in those cretaceous beds, some of them so much abound, leads to some hesitation in relying implicitly on the alleged much lower stratigraphical position of some foreign forms. The foreign forms from the true chalk appear to be few and rare; but there are several figures in Goldfuss, to some of which I have already alluded‡, probably representing forms belonging to this family, which are there given as from the "Jurakalk." In the

* In addition to the acknowledgements which I have already made, I have the further pleasure of now recording the kindness, in affording me the means of examining different specimens from very various localities, of Mr. Lyell, Mr. Wetherell and Mr. Oakeshott of Highgate, Mr. Cunningham of Devizes, Mr. Catt of Brighton, and Mr. Whittle of St. John's College, Cambridge, besides that of Mr. Charlesworth as above-mentioned. I must also acknowledge the kind assistance afforded me by Mr. Waterhouse of the British Museum, in facilitating the task of inspecting the specimens in that collection. To the President of the Geological Society I am also indebted for the prompt courtesy with which he has enabled me to avail myself efficiently of illustrations from the valuable museum of that Society.

I would take this opportunity of saying that I shall be greatly obliged by any illustrations and opportunities similar to those which have already been so kindly and liberally afforded to me.

† See observations in the Ann. and Mag. of Nat. Hist. vol. xx. p. 337. An interest beyond even that which they are calculated intrinsically to excite is thus given to these fossils, of the same nature as that which attaches to a series of Ammonites from different beds.

‡ *Ante*, vol. xx. p. 78. It is proper to state that there are many forms, besides those thus specified, figured by Goldfuss as from the Jurakalk, and which I have not much doubt are *Ventriculidæ*. I have only enumerated the more obvious.

British Museum, again, is a large and valuable series of fossils, which I have carefully examined, and which I can therefore state with assured confidence to belong to this family*, and which are stated to be from Mount Rhanden in Switzerland; a locality the strata of which are declared to be equivalent to the lower beds of the Middle Oolite of England. The matrix *appears* much the same as that of our English chalk marl; but that test is, of course, very incomplete. The point requires careful investigation; and, as the true character and importance of these fossils will have now become known, it may be hoped that the attention of some of the many competent foreign observers may be directed to it. As I shall show the changes which these forms have undergone in passing from one division of our English strata to another to have been great, it will be peculiarly interesting to ascertain exactly to what strata these foreign forms do actually belong; for many of them differ much from our English forms. It is interesting at present to remark that the form which is of the greatest vertical range in the English beds (*Brachiolites digitatus*) is unequivocally found in these Rhanden beds.

In p. 510 of the first volume of the Journal of the Geological Society there is described by Mr. Lonsdale, under the name of "*Ocellaria ramosa*," a fossil found by Mr. Lyell in the Eocene deposits at Jacksonborough in Georgia, United States. Did this fossil exhibit any true affinities with the group which has been called *Ocellaria* it would necessarily belong to the Ventriculidæ, and I was anxious to ascertain the facts. Mr. Lyell has obligingly enabled me to do this by placing in my hands all the specimens found by him, and which are, it is believed, all that have ever been found. The result is, that the fossil is found to present none whatever of the characters of *Ocellaria*; and I cannot understand upon what grounds it has had this name affixed to it by Mr. Lonsdale, except that he appears, from his observations, never to have had an opportunity of examining any actual specimens of the so-called *Ocellaria*, and to have been misled by some of the figures †. These fossils however answer to no part of the generic description given by Ramond, or any subsequent writer, of the *Ocellaria*. The tubules in the Eocene fossils are tubules ramifying through a massive substance, and there is not any polyparium which is "*explanato-membranaceum*," and "*utro-*

* These treasures are at present unarranged. I should be happy to assist in that task, and to complete it by adding, as far as possible from my private collection, all the British forms, should the present Commission result in any prospect of improvement in that respect.

† The figure specially referred to, and which is copied by Lamouroux, pl. 72, fig. 5, has certainly a considerable resemblance to a special fractured surface of the Eocene fossil.

que latere porosum." The characters of *Ocellaria*, as given by all the authors*, are clear and unmistakeable so far as they go; and there cannot be a moment's doubt as to what the true relations of the so-called genus are, as will presently be seen. It is perfectly certain that this so-called *Ocellaria ramosa*† has none of these relations, and therefore that it does not serve to bring the Ventriculidæ within the tertiary period. No trace of this family has, then, yet been anywhere discovered higher than the upper beds of the English chalk.

As it is desirable to have the treatment of the subject as complete as possible, so far as it goes, and as the materials which I have collected from the English chalk are sufficiently abundant to lead me to hope that such completeness may be given, for all practical purposes, to the description of the forms found in those beds, I shall confine myself at present to these last; which I do rather do in that, while it would be *à priori* probable that the examination of so extensive a series of beds would at any rate afford a full series of typical characters,—and therefore a sound basis for a permanent and generally applicable system of classification,—the examination of the Rhanden specimens in the British Museum has satisfied me that all of them will range within the typical groups which the forms of the English chalk have led me to assign.

I have already indicated‡ in what direction we must look for the essential characters which mark this whole family. It is extremely improbable that a structure so extraordinary, so peculiarly bearing the marks of special design and adaptation as the octahedral structure, should be otherwise than characteristic of the family in individuals of which its existence has been discovered. Until, then, it has been found elsewhere, the philosophical inquirer will take that structure as his guide in the deter-

* Those characters are, "Polypier pierreux, aplati en membrane, diversement contourné, subinfundibuliformée, à superficie arénacée, muni de pores sur les deux faces." The observations of Milne-Edwards, on an inspection of the actual fossils, are alone sufficient to show that the present fossils could not be *Ocellariæ*, their apparent tubules being, as stated in p. 511, sometimes penetrated by fibres in a radiated manner. Milne-Edwards expressly says (Lamarck, Anim. sans Vert. ii. p. 291), "L'axe solide, qui remplit assez ordinairement les trous, et qui a été pris pour une partie du Polypier lui-même, n'est que la gangue qui s'est moulée dans ces trous, et qui s'est cassée au niveau de la surface du Polypier, lorsque celui-ci a été détaché de la masse qui le renfermait."

† The fossil is however a very curious and interesting one. Its whole aspect and character recall those of the Alcyonium, both in its massiveness, its cylindrical tubules, and their connecting plexus of fibres. I have many analogous fossils from the chalk, into the investigation of which it is my intention to enter when the present subject shall be completed.

‡ *Ante*, vol. xx. p. 182.

mination of the members of this family. My careful attention has therefore been directed to ascertaining the presence of that structure under every various mask of external form, and I have hitherto invariably found that presence accompanied by certain other characteristics, which would necessarily be present if the affinities which I have already attempted to show are those of the Ventriculidæ be the true ones. Without full confidence in the Law of Unity as a sure guide, I cannot conceive of any progress being made in any scientific investigation. I have not found that guide to fail me yet in the present investigation, and am therefore content to take it as the basis of such exposition as I am now able to give of the genera and species of the family VENTRICULIDÆ.

Proceeding therefore on this basis, it may be stated generally, that all those fossils which are marked by a membranous structure made up of cubic squares, with equally subtending octahedral fibre at the angles of union of those squares, belong to the family Ventriculidæ, and that all members of that family are marked by that structure. We shall find, it is true, thus associated forms externally most diverse*, and the alleged affinity of which would at first sight startle the inquirer; which have indeed hitherto had places the most different assigned to them: but I shall be able to show that other and most interesting Unities prevail through all these various forms in addition to that structural one; and these diversities will thus become only another useful addition to the often repeated but too often neglected lesson, that no guide is more fallacious than likeness or unlikeness of mere external form †.

“A natural classification,” says Milne-Edwards, “is nothing else than a description of the modifications, more or less important, observed in the structure of animals, and a specification of the differing degrees of likeness or unlikeness which the latter bear to each other ‡.” Nothing is easier than the multiplication of genera and species. But it is no slight task, though a most important one, to determine what are the material modifications on which distinction of genus should be founded; what the ma-

* On the other hand, I shall take a future opportunity of showing that forms externally bearing much resemblance to the Ventriculidæ have in truth a very different structure and affinities.

† Parkinson long ago remarked, that “if the *figure* of the fossil be assumed as the leading character of the species, substances, differing materially in their structure, will be classed together in the same species; and, on the other hand, if the species be formed on the external *structure*, we shall have under the same species substances differing widely in their forms.” Vol. ii. p. 128. It would have been well if Goldfuss and others had paid a little attention to these important truths.

‡ Sur les Crisies, &c., p. 233.

terial points of likeness or unlikeness which should mark separate species*.

The only principle upon which I can understand any philosophical or natural classification to be founded, is the taking some principal and most easily recognizable point in the œconomy of the living animal, and examining all the individuals under review in reference to that one point.

It has been already seen that the Ventriculidæ belong to a high type of the Molluscan Polyyps,—to the Polyzoa,—approaching most nearly to the recent *Eschara* and *Halodactylus*. The fossilized remains of animals of this order, the organization of whose recent congeners has been but so lately understood, might seem at first sight to baffle any attempt to seize on such a point. It seems to me however that such a one may be found. In all recent animals of this order the first essential to their life and well-being is the presence and free access of the sea-water. Various contrivances are adopted to secure this end,—some genera and species being parasitical, some loosely floating, some stiffly erect; each, varying as they also do in form, adapted to the peculiar circumstances of the locality which it inhabits, and each, according to the particular plan adopted, exhibiting some characteristic differences in habit and organs. This is precisely consistent with the observations already made† as to the constant relation existing between the polypidom, *rightly examined*, and the nature of the inhabiting polyyps. Such differences no doubt existed in the recent Ventriculidæ; and though it is obviously impossible that we should ever be able, in these fossils, to ascertain the points of difference in habits and individual organs, we may, by care and patience, ascertain those differences in the contrivances displayed in the structure of the polypidoms which we must thus be satisfied were intimately and necessarily connected with such differences in habits and individual organs. I allude to the various modes of folding of the delicate membrane‡ which forms the framework of every individual of this family, and on whose surface the minute and numberless colony of polyyps dwelt. I ap-

* Were I to follow the example of some botanists, who, for example, in a favourite tribe, the *Cactus*, have amused themselves with hair-splitting of genera to a marvellous extent, I might readily succeed in perplexing the inquirer with a great multitude of unintelligible names. Between many of the species which I have grouped together, differences far more marked exist than those by which these gentlemen—and too many palæontologists—have overlaid the intelligibility of their classifications as *generic* distinctions.

† *Ante*, vol. xx. p. 177–179.

‡ A membrane, it will be remembered, which, by its structure, was firm like the *Eschara* (though not calcareous), and not loosely floating like the *Halodactylus*. This is important in considering the permanence of the different modes of folding adopted.

prehend that it can need no detail of argument or mathematical demonstration to show, that upon the mode and degree of folding of this membrane, the greater or less freedom of access, change, and circulation of the water, and its consequent power of being acted upon by the numerous ciliated tentacles and moveable processes, must have depended. Every one who is familiar with the difference in mere circulation of air between the narrow street and the open road, between the deep valley and the hill top, will recognise the essential importance in this respect of every difference in that mode and degree of folding; and, when the extreme minuteness of the individuals is considered, it will appear that variations of fold hardly appreciable to the eye will have probably had a material influence on the condition of the tenants of these wonderful structures. I cannot doubt that every *constant* difference in the mode and degree of folding of the Ventriculitic membrane was accompanied by some modification in the organs or habits of the animals, adapting them to that particular mode and degree of access, change, and circulation of sea-water which that mode and degree of folding made a matter of absolute necessity*.

Taking then the Ventriculidæ as a family of the *Polyzoa*, I shall first endeavour to show that there are certain broad and very marked constant modifications in the mode of folding† characterizing certain extensive groups which yet have many points of constant difference between the individuals which, as groups, are respectively thus characterized. These groups will form distinct genera. I shall show that certain subordinate but yet important modifications mark, in common, several of the individuals of each of these genera, which individuals yet have further still subordinate but constant and therefore characteristic points

* Sir J. G. Dalyell, in his recent work on 'Remarkable Animals of Scotland,' especially notices the importance of attention to the *varying* condition of the water in which specimens are kept as the great secret of their preservation; and even his care has often failed. A "low organization" and slight sensibility have been hastily attributed to Polyzoa from their enduring great changes of heat and cold. There is no animal capable of enduring greater changes in this respect than man. But take another class, and it is well-known that from the same heap of frozen fish one may be dashed to shivers on the ground, while another, put into a pail of water, will, in two minutes, be swimming about.

† The inquirer will at once perceive the difference between this and mere external form. The same general external form may mask numberless most different modes of folding. My object is to aid in realizing, by classification, the living animal in all its integrity and varieties. By the accumulated names *Scyphia*, *Coscinopora*, *Guettardia*, &c., nothing ever was or can be vivified; no real idea conveyed to the mind. But the object of the naturalist should surely be, not an accumulation of mere *names*, but the realization of living and true ideas of various absolute modes of actual existence, be they past or present.

of difference. The inquirer is thus further relieved from the detail of specific differences by the division of each genus into sections. The still subordinate but constant points of difference last named will be characteristic of species.

I have already alluded to the important and valuable test of the soundness of these principles of classification afforded, unexpectedly and after the work was completed, by the stratigraphical harmony exhibited by the table of classification. It will be sufficiently obvious that the ocean of different ages would have such modifications as would not be adapted equally to all varieties. We accordingly find among the Ventriculidæ, as in other divisions of palæontology, a few species enduring through many changes; others dying out; while with every fresh æra fresh forms display themselves.

It will be understood from this, that mere *size* does not enter as an element into the determination of genus or species. Of many species I have specimens from an inch to eight or nine inches in diameter. It is not necessary to enter very fully, therefore, into the question of *growth*. That question, always a difficult one in palæontology, is difficult even in recent forms of the families allied to the Ventriculidæ. It would be vain to hope to throw much light upon it by fossil forms. Where *constant* differences are found under all varieties of size, we are bound to consider them as distinct species. I shall touch briefly on the question of growth in introducing each separate genus.

It will be also understood that the mere external (outward or inward) general *form* of the fossil does not enter as an element into the determination of genus or species. I have shown how deceptive that criterion must ever be. In the present instance the same general external form conceals essential differences in the mode and degree of folding of the membrane.

It will occur to the reader that to follow the fold of a membrane, the trace of which is preserved only in a hard and solid matrix, must be a work of great difficulty; and especially when that matrix is either so friable as the chalk, or so impracticable as the flint. The actual amount of the difficulty* cannot however be fully appreciated without actual experiment. The presence of that very oxide of iron, without which the forms could not be, in general,

* In order that the actual nature, importance, and results of the present investigation should be properly understood, it is necessary to remind the reader that from the time of Dr. Mantell's first work to his latest, and either by him or the other latest writers (see Portlock's 'Report, &c.' p. 342), it has never been suggested or suspected that *any membrane whatever existed* in any of the Ventriculidæ. They all describe them as composed of anastomosing "*cylindrical fibres*," (see *ante*, vol. xx. p. 76,) between which, on the inside, papillæ or tubuli arise. I have demonstrated that the basis of the Ventriculidæ is a simple unperforated membrane; that, therefore, the

even detected, necessarily stains the matrix beyond the structure itself; and it requires the nicest and most painful discrimination to determine what is due to structure and what to mere iron stain. Feeling however that such a course of investigation could furnish the only true materials of a natural classification, I have endeavoured to overcome these difficulties. And it may save the task both of making and answering many objections if I now state that I have, with this object, dissected with elaborate care numberless specimens, in addition to many hundreds of sections of specimens both in flint and chalk, which, with the like purpose, I have made. There is not one species which I have established which I have not determined from actual and personal section of specimens either in chalk or flint, usually both, and in which, with scarcely an exception, I have not followed and traced out the actual fold with the knife and needle.

My aim has been to present such a classification and nomenclature as should be intelligible and at the same time expressive; which, whether respect be had to genus, section, or species, should give some accurate and specific idea of the point on which the respective division has been founded; that thus a mere inspection of the table of classification may carry with it some real and true ideas as to the objects included*. The name

descriptions so long before the world, and so often repeated, are fundamentally erroneous,—the conclusions as to the œconomy of the animal being necessarily, therefore, as fundamentally erroneous. It is upon the same laborious care which has enabled me to demonstrate these facts, that I rely in attempting the descriptions now to be given of the different *modes of folding* assumed by that membrane, and the superficial appearances of which have misled these observers.

* It is usually unadvisable to alter names once applied; but where the character of an object has been wholly misunderstood, not even its generic or structural character having been known (see the last note), there can be no claim to retain old names. Their retention is then generally mischievous as a mere perpetuation of error. I fully agree with Dr. Farre (*ut ante*, p. 405, note) that oftentimes “confusion and doubt (in nomenclature) can only be dispelled by beginning *de novo*,” and so applying new names in harmony with a system founded in nature and upon some definite principle. I think it better to give here all the names which occur in Mr. Morris’s Catalogue whose objects appear to belong to the Ventriculidæ,—a list which will, moreover, show the “confusion and doubt” which have hitherto prevailed in the nomenclature of this family.

Names in Morris’s Catalogue.

Choanites flexuosus
 Choanites subrotundus
 Ventriculites alcyonides [Ocellaria]
 — alternans
 — Bennettiæ

In the following classification.

Ventriculites latiplicatus.
 Cephalites constrictus.
 Ventriculites quincuncialis.
 Probably V. bicomplacatus.
 One of the Cephalites annulati, but no accurate description; and the figures of Michelin and Mantell totally differ.

applied to the whole family and to the first genus is the only apparent exception to this rule*. The name *Ventriculites* would certainly not have been applied to any of these bodies, or to the family, by myself. It was applied by Dr. Mantell to the few forms found by him, under the idea of the internal cavity being the true digestive surface of a single animal. Though the idea under which the name was thus applied has been shown to be wholly erroneous, I have been unwilling, out of respect to the many labours of Dr. Mantell in the field of palæontology, to reject, as others have done without assigning any reason, this generic appellation; and I have justified myself in its retention by the classical use of the same word, though in a secondary sense only, in a very different way, viz. as applied to mere saciform cavities†. It will be understood, therefore, that the terms *Ventriculidæ* and *Ventriculites* bear no reference to any digestive cavity, but simply to the fact of the creatures to which they are applied always assuming forms which display a central cavity more or less simple. I am glad that this modification in the meaning of the word enables me to retain a name which will always bring to the inquirer's recollection the long and successful labours of Dr. Mantell.

It is impossible to examine an extensive series of remains exhibiting the characteristic structure of the *Ventriculidæ*, without perceiving that, however widely in other respects the individuals differ from one another in the mode of fold of their membrane, they all range themselves within one or the other of three strongly marked and constant modifications, quite independent of mere size.

The first in natural order, as having most of that simple *pouch* form which is implied in the name *Ventriculidæ* as above ex-

Names in Morris's Catalogue.

Ventriculites infundibuliformis

— quadrangularis

— quadratus

— radiatus

Ocellaria inclusa

— nuda

Spongites Townsendi

— labyrinthica

Scyphia Fittoni

In the following classification.

Ventriculites cavatus or *bicomplacatus*.

Brachiolites angularis.

? not a *Ventriculid*.

Ventriculites radiatus.

— quincuncialis.

Ibid.

Ventriculites simplex.

Brachiolites convolutus.

Fragment of *Brachiolites digitatus*.

* The termination "*ites*" is not in itself very classical, but has been so generally employed as to be a convenient and intelligible distinctive mark of fossil generic appellation. Hence I retain it in "*Ventriculites*," and am therefore obliged so to terminate the other generic names. I am glad to be able to retain, consistently, Dr. Mantell's specific name *radiatus*.

† Thus Cicero: "Ex ea [anima] pars concipitur cordis parte quadam, quam *ventriculum* cordis appellant, cui similis alter adjunctus est in quem sanguis a jecore per venam illam cavam influit."—*De Nat. Deor.* ii. § 55.

plained, are a large number whose general form is that of a more or less open or close sac, the wall of which rounds or thins off to a marginal edge. All of this kind are single, and supported on a single root, unless in those few abnormal cases before mentioned*, and which afford no exception to the principle either of the structure or classification. Where, as very rarely occurs, two are united, it is at the roots that they are united. They are not branches of one body.

All these forms I distinguish by the name of *VENTRICULITES*.

Next to these are naturally placed another group, all the members of which are much rarer than the last, most of them of great rarity, but yet exhibiting a diversity of forms as great, well-marked and constant as the different individuals of the genus *Ventriculites*. All however are marked by the very striking peculiarity of the wall of the pouch not thinning or rounding off to a marginal edge, but being crowned by a broad and distinct head, prominent and well-defined, and totally differing in aspect, structure, and function from the rest of the body. This characteristic suggests, as peculiarly appropriate, the generic appellation of *CEPHALITES*.

The two genera thus distinguished each exhibit, though with striking modifications, more or less of the simple pouch form in their internal cavity, or of obvious singleness in the general shape which the fold of the wall of their cavities, or their apolypous head, assumes; but a large group remains to which neither character applies, and all the members of which stand out conspicuously as folded in many lobes and in many broadly separated parts. The word *brachium* being often used by the best authors in the sense of projection simply, I use the diminutive of that word to distinguish all of this group by the name of *BRACHIOLITES*.

But, again, the individuals comprised within the description of the genus *Ventriculites* are found to exhibit two broad modifications in the general aspect of the membrane composing the wall of the pouch. The two sides of the wall correspond in the one group, both surfaces being either smooth, or, if marked with folds, the depression of one side having a corresponding elevation on the other; in the other this correspondence is absent, owing to some change in the direction of the fold before reaching the opposite surface, as already alluded to†. It will materially assist the memory and researches of the inquirer if we accordingly divide the genus *Ventriculites* into two sections, which I distinguish by the names *Simplices* for those species having corresponding surfaces, *Complicati* for those which change the direction of their fold between the two surfaces.

* *Ante*, vol. xx. p. 90.

† *Ante*, vol. xx. p. 88.

So the individuals comprised within the description of the genus *Cephalites* exhibit two broadly-marked modifications; the head of the one group being only of the same breadth as the thickness of the wall, and being placed exactly at the top of that wall, and nearly at right angles, at every point, to the outer and inner surfaces of that wall; the head of the other group being much broader than the thickness of any part of the wall, and never lying flat at the top, but extending more or less down over the sides of the wall. These marked differences are accompanied by important differences in the mode of fold of the membrane. I distinguish therefore the genus *Cephalites* into the two sections *Annulati*, being those in which the head extends as a mere broad ring round the flat top of the wall, and *Dilatati*, being those in which it is spread out so much more extensively.

And so also the members of the genus *Brachiolites* are at once separated into two groups, by the remarkable circumstance that some of them have the extremities of those projecting lobes into which they are divided *open*, others *closed*. The latter I distinguish as the sectional division *Operti*, the former as *Aperti*.

I shall hereafter point out the minor modifications accompanying these more striking ones, and endeavour to show the final purposes of the respective modifications themselves.

It will of course be well understood that, as in every class of fossil forms the exact determination of the species of individual specimens is often difficult, frequently impossible, such must sometimes be the case with respect to the *Ventriculidæ*. The conditions under which they are found render them peculiarly liable to this difficulty; and the inexperienced observer who has not yet learned to distinguish that which is a mere *cast** from a specimen in which some of the actual body is preserved,—a task of no slight difficulty, and only to be successfully undertaken after acquiring a full knowledge of structure,—will often find himself baffled in the attempt at specific identification. Hence the importance of attention to those sectional and generic characters already noticed, and which he will rarely be unable to distinguish.

These broad modifications, and the respective relations thereto

* Michelin's *Ocellaria grandipora*, pl. 40. 3a & 3b, is a mere *cast* of external and internal surfaces. The imperfection and indefiniteness of almost all the figures yet published have been already noticed (*ante*, vol. xx. p. 78-80). It would therefore be a useless attempt to endeavour to identify them. Objects of this class require to be well understood before they can be truthfully represented by figures. The figures of Dr. Mantell are no exception to this remark, as they only give the broad external characters of one species (which they however do) without any indication of the mode of fold of the membrane which gives rise to those characters, and the very existence of which membrane Dr. Mantell denies.

of the minor modifications, will be the better understood from the following table of classification, in which I have arranged the species belonging to each genus in such relative position as should best display the transition from one general character of folding to another, and thus gradually realize the true relations existing between the very different forms which lie at the two extremes.

Class MOLLUSCA TUNICATA*.

Order POLYZOA †.

Family VENTRICULIDÆ.

VENTRICULITES, <i>Mant.</i>	CEPHALITES.	BRACHIOLITES.
§ a. SIMPLICES.	§ a. ANNULATI.	§ a. OPERTI.
1. simplex.	1. longitudinalis.	1. tuberosus.
2. impressus.	2. guttatus.	2. elegans.
3. quincuncialis.	3. paradoxus.	3. convolutus.
4. muricatus.	4. alternans.	4. angularis.
5. tessellatus.	5. bullatus.	
6. cavatus.	6. retrusus.	§ b. APERTI.
7. striatus.	7. catenifer.	1. foliaceus.
	<i>Var. annulatus.</i>	2. racemosus.
§ b. COMPLICATI.	8. compressus.	3. digitatus.
1. mammillaris.	§ b. DILATATI.	4. tubulatus.
2. latiplicatus.	1. capitatus.	5. fenestratus.
3. decurrens.	2. campanulatus.	6. labrosus.
<i>Var. tenuiplicatus.</i>	3. constrictus.	7. protensus.
4. radiatus, <i>Mantell.</i>	4. perforatus.	
5. bicomplacatus.		

* It is quite beyond my present purpose to discuss the exact position of the Polyzoa. The main truth of Professor E. Forbes's opinion is however so generally recognized, that I am justified in the above designation of *class*, which must always be felt to be an important element in giving vitality to a classification. Professor Forbes says, "The anatomical structure of the Ascidioida or Bryozoa removes them altogether from the class of Zoophyta into that of Mollusca, where they should form an order of Mollusca tunicata parallel with the group of compound Tunicata of which *Botryllus* and such forms are examples."—Ann. and Mag. of Nat. Hist. vol. xiv. p. 390. See Owen's Lect. on Comp. Anat. I. pp. 100 and 269, 270; Van Beneden, Recherches sur les Bryozaires, p. 37; Johnston's British Zoophytes, p. 2. (See also Thompson and Farre.) The actual and important distinctions are noticed by the last writer, p. 256; and the vast superiority in vital activity of the Polyzoa to the Ascidioids, is well pointed out by Sir J. G. Dalzell (*ut ante*) pp. 229, 230. I have heretofore used the general term "zoophytes" in conformity, as already intimated (vol. xx. p. 190), to what is at present the ordinary language of authors, and a departure from which would, therefore, have caused ambiguity and unnecessary confusion.

† *Thompson; Bryozoa, Ehrenberg; Ciliobrachiata, Farre.*

[To be continued.]